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APPLICATION ELEMENTS

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- ☒ Fee Transmittal Form
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2. ☒ Specification Total pages [31]
(preferred arrangement set forth below)
- Descriptive title of the invention
 - Cross references to Related Applications
 - Statement Regarding Fed sponsored R&D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings
 - Detailed Description
 - Claims
 - Abstract of the Disclosure
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4. ☒ Oath or Declaration (Total Pages) [3]
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- b. ☐ Copy from a prior application
(37 CFR 1.63(d))
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Signed statement attached deleting
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Applicant or Patentee: David Cushing
Serial or Patent No.: _____ Attorney's Docket No. 2566-104A
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For: METHOD AND SYSTEM FOR OBTAINING A DISCOVERED PRICE

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NAME OF CONCERN ITG, Inc.
ADDRESS OF CONCERN 380 Madison Avenue, New York, New York 10017

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

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TITLE OF PERSON OTHER THAN OWNER MANAGING DIRECTOR

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SIGNATURE

David C. Cushing

Date

1/28/00

METHOD AND SYSTEM FOR OBTAINING A DISCOVERED PRICE

FIELD OF THE INVENTION

5 This invention relates generally to securities markets. Particularly, the invention relates to a system and method for determining an optimal price at which to conduct batch auctions of securities and other assets.

BACKGROUND OF INVENTION

10 A securities trading mechanism can be thought of as a set of protocols that translate a group of investors' latent demands into realized prices and quantities.

15 Batch auctions are often used as the blueprint trading mechanism for new, automated trading systems such as that disclosed by U.S. Patent No. 5,873,071 to Ferstenberg et al. and the systems in use by the Arizona Stock Exchange ("AZX") and the Pacific Stock Exchange ("PSE"). A batch auction is a type of
20 traders simultaneously buy or sell one or more securities at an agreed upon price for each security.

The Ferstenberg et al. patent discloses a method and system for performing off-market intermediated trades of financial securities using periodically conducted batch auctions. In the Ferstenberg system, trades executed during each auction cycle are transacted at a price set equal to the midpoint of the bid-offer spread as quoted by the underlying primary market for the security. The POSIT™ electronic trading system operates in a similar manner to that described in the Ferstenberg patent. Order requests, containing one or more trade orders for one or more assets, are entered into the POSIT system and the trade orders are matched, or "crossed." The matching attempts to satisfy as many of the trade orders in the system as possible. Once the matching is complete, all matched trades within the system are executed at a price equal to the mid-point of the most recently quoted bid-offer spread.

The Arizona Stock Exchange ("AZX") operates solely in a batch auction market format. The AZX has a high degree of transparency in that traders are permitted to view a large portion of the order book prior to a given auction, as well as view beforehand the exact price at which trades would occur. Trade price for each security traded in the auction is selected from one of three prices dictated by the underlying primary market for that security; the highest volume maximizing price, the lowest volume maximizing price, or the mid-point of those two. If bids outweigh offers, then the higher offer price is used. Conversely, if offers dominate, then the bid price is used for the auction. Only if supply and demand are exactly equal, the mid-point of the quoted spread is used as the auction price. Collectively, these attributes put may put traders at

informational disadvantages or lead to "gaming" (price manipulation by traders), thus preventing accurate price formation and discouraging order entry.

5 The OptiMark™ electronic trading system employed
by the PSE conducts repeated batch auctions over the
course of a market day similar in manner to the AZX,
but offers less transparency in that the order book is
kept confidential. The OptiMark system generates
multiple prices for each security traded in each
10 auction such that, for example, all sellers of a
particular stock during a given auction are not given
the same price. This result is very undesirable to
traders, especially when large blocks of shares are
traded as is commonly done in batch auctions.

15 U.S. Patent No. 6,012,046 to Lupien et al.
discloses an electronic securities trading system for
crossing orders based upon a price and quantity
satisfaction profile specific to each trader.
Participating traders submit such a profile in two-
20 dimensional matrix form for each stock they desire to
trade in. This matrix is used by traders to specify
relative pricing satisfaction information for each
stock, and trades are conducted at a price determined
from the relative pricing information. The Lupien
25 patent, however, teaches an allocation of the exchanged
stock shares among traders based upon time and price
priority of the orders. This priority feature often
causes the inherent drawback of disparities in fill
rates and prices among participating traders which are
30 undesirable in the financial community. Furthermore,
the complexity of the order entry process, including
the completion of a price matrix for each asset desired
to be traded and the lack of market order support,
makes such a system unfriendly to traders.

U.S. Patent No. 5,950,176 to Keiser et al.
discloses an electronic securities trading system which
uses a computer program to project price movement of
securities and set suggested prices for trading in
5 continuous trading markets. This system however does
not solve the problems attendant in batch auction
methods and systems where providing optimal price
determination is hampered by gaming and low liquidity.

The prior art approaches to setting the
10 transaction prices of securities during batch auctions
have numerous drawbacks. The existence of order books
having high levels of transparency and different
execution priority rules, as used by the AZX, produce
undesirable disparities in fill rates, discourages
15 order entry and may lead to gaming. An additional
drawback of such a batch auction design is that it
often is not sufficient to produce accurate pricing in
low liquidity, high volatility markets as is present
for thinly traded stocks. Price discrimination among
20 traders within a single auction based upon their order
types and the use of highly complex order formats, as
done by the PSE OptiMark system and the Lupien patent,
can cause dissatisfaction among participating traders
with the outcome produced by the auction system.

25 Due to the above-mentioned and other drawbacks,
there remains a need in the art for improved price
setting methods and systems to sufficiently and
efficiently conduct batch auctions of financial
securities in financial markets.

30 SUMMARY OF THE INVENTION

Therefore, it is an object of the present
invention to provide a method and system for performing

securities transactions via a batch auction, whereby the system conducts the auction at a single price.

It is also an object of the present invention to provide a method and system for performing batch
5 auctions of securities wherein an optimal price is chosen which more fully reflects the impact of supply and demand.

Further, it is an object of the invention to provide a method and system for performing batch
10 auctions of financial assets whereby the price at which the auction occurs is dictated by the order requests of traders.

Additionally, it is an object of the present invention to provide a method and system for performing
15 such transactions which provides for selecting an appropriate auction price when matched orders within the auction do not identify an optimal price.

Finally, it is an object of the present invention to provide a method and system for conducting batch or
20 call auctions which calculates a single optimal price for each asset, and then fairly allocates trades of each asset executed at that optimal price among orders.

The present invention provides a method and system for determining (or "discovering") a price and share
25 quantity based on the aggregate supply and demand represented by all orders submitted for a given auction. The method and system can be advantageously used for trading in financial assets on, for example, Nasdaq, POSIT and in electronic communications networks
30 ("ECNs"). Financial assets according to the present invention include stocks, bonds, commodities, options, futures contracts, pollution rights as well as other tangible and intangible goods and rights. A full iteration of the system, comprised sequentially of an

order acceptance period, a price discovery period, and an order execution period, is referred to as an "auction cycle". Each batch auction cycle is typified in that a series of investors simultaneously trade, i.e., buy or sell, a stock at a single price. Auction cycles according to the present invention operate at pre-determined times that are known to qualified auction participants, such as (but not limited to) traders.

One aspect of the invention comprises a method for performing a batch auction whereby a series of orders, according to a variety of predetermined order types, are generated by qualified market participants and communicated to the auction system. The system takes into account each order and its impact upon relative supply and demand. For each security in question, bids and offers are crossed to determine by a preset algorithm a "discovered" price and share transaction quantity. Trades are executed, and a portion of the transaction quantity is allocated to each investor on a fair basis dependent upon their initial orders.

In preferred embodiments of the present invention, the auction method is performed using a computer system or network designed to automatically perform one or more steps of the method. Qualified market participants therefore may submit orders to the auction system electronically whereby the orders are then electronically stored, such as in a computer database, until such time as the orders are modified or canceled by the submitting participant or until commencement of the price discovery period. During the price discovery period, orders received during the order acceptance period are crossed according to a present price discovery algorithm being performed by software running

on one or more computers. Using the algorithm, the computer identifies an optimal price and allocation of trades. These trades are then executed at the optimal price and returned to the qualified participant during the subsequent order execution period.

Another embodiment of the present invention comprises an electronic system for conducting batch auctions of securities. Such a system can be comprised of a computer network designed to accept a plurality of orders from a variety of sources. At a predetermined time, all current orders are crossed according to a preset price discovery algorithm to determine an optimal share price and quantity for each security being traded. A trade of shares in an amount equal to the quantity is automatically executed by the system at the discovered price, and then fairly allocated to each order source. Therefore, a computer system according to the present invention, comprised of software and accompanying hardware, would permit auction participants electronically and automatically to carry out the intermediated exchange of assets at a market determined optimal price.

The present invention will become more fully understood from the forthcoming detailed description of preferred embodiments read in conjunction with the accompanying drawings. Both the detailed description and the drawings are given by way of illustration only, and are not limitative of the present invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a flow chart generally depicting the method whereby the price for a particular asset in a

given auction is selected according to embodiments of the present invention;

Figure 2 is a flow chart depicting the method whereby the price discovery algorithm is used to discover an optimal price according to embodiments of the present invention;

Figure 3 is a flow chart depicting the method whereby the reference price algorithm is used to identify a reference price according to embodiments of the present invention; and

Figure 4 is a schematic diagram demonstrating the interaction of various factors during operation of a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Each auction cycle in a batch system is typified in that a series of investors simultaneously trade, i.e., buy or sell, a stock at a single price. The present invention comprises a method and system for conducting an intermediated batch auction of financial assets by crossing order requests from a plurality of traders as is described in detail by U.S. Patent No. 5,873,071 to Ferstenberg et al., the specification of which is herein incorporated by reference. This crossing process generally entails an iterative process whereby a substantially maximized amount of each asset within the auction is exchanged amongst participants, subject to the constraints that for each asset exchanged, the total amount of shares sold equals the total amount of shares bought by all participants, and the amount bought or sold by each participant is within that participant's acceptable bounds. According to the present invention, all shares of a given asset are exchanged during each auction at a single price,

preferably an optimal price, determined from the supply and demand imbalances produced by crossed orders.

A batch auction cycle of the present invention is comprised of three sequential periods: an order
5 acceptance period, a price discovery period, and an order execution period. During the order acceptance period, the system accepts orders from qualified participants. The definition of a qualified
10 participant will vary as is known in the art depending on how the system is implemented, as well as on the types of financial instruments traded and the country in which it is operated. This definition will often depend on whether the system is implemented as a
15 facility of an established market or exchange. In this case, who are deemed qualified participants will likely be defined or limited by the exchange's rules.

Each order submitted essentially represents the bounds, as defined by the order-submitting trader, within which a purchase/sale of a financial asset is
20 desired. All orders generally are comprised of a trade "side" (buy or sell), an asset identifier (such as the name or symbol of a security), and a quantity of shares. In embodiments of the present invention, a
25 variety of order types can be used by traders to more thoroughly describe the conditions under which they desire to trade.

A first general category of such order types is "unpriced orders." The submission of an unpriced order to the system identifies a desire by the submitter to
30 participate in the auction at whatever price is discovered (if any) during the later price discovery period. If no price is discovered during the price discovery period, unpriced orders would be matched at a predefined reference price. An unpriced order for a

given auction cycle is fully specified by the above three basic elements: a security identifier, an order quantity, and a trade side.

Optionally, a maximum (minimum) acceptable
5 transaction price can be specified in an unpriced buy or sell order ("I will not sell for less than \$100.00 per share"). This price, however, serves as an extreme upper and lower limit and will thus not influence the price discovery algorithm as it is described below with
10 respect to the price discovery period.

Another general category of such order types which can be submitted to the system is "priced orders." Priced orders are fully specified by four elements: security identifier, order quantity, trade side (i.e.
15 buy or sell), and a desired price. This desired price represents an offer by the trader (e.g., "I will sell X shares for \$100.00 per share"), and is used during the price discovery period, described in detail below, to determine the price at which the auction will take
20 place.

In preferred embodiments of the present invention, at the user's option, any unexecuted shares (due to a mismatch in buy and sell orders) of a priced order after the order execution period can be automatically
25 forwarded to another ("secondary") destination at the end of the auction cycle. While not all destinations will necessarily be supported, the user will be able to choose among supported destinations. Where practical, support for unique order attributes of a particular
30 secondary destination, such as "reserve quantity," or "pegging", etc., will be provided.

Additionally, in preferred embodiments of the present invention, the supplied price stated in priced orders, and the optional minimum/maximum transaction

limit prices stated in unpriced orders, may be supplied in terms of the quoted market for the underlying security, such as equal to the bid, offer, or the mid-point of the bid-offer spread. Alternatively, the
5 supplied price and limit price can be stated in variable form dependent upon fluctuations of known market indicators (e.g., futures price movement) and indices (e.g., the S&P 500) which occur between the
10 time the order is submitted and the time the auction begins. Such relative priced and unpriced orders could, for example, represent the traders desire to not pay more than the current offer on the underlying market, or to have the order protected against an interim precipitous drop in a given market index.

15 A third category of orders which may be submitted according to embodiments of the present invention is "cross orders." A cross order is similar to an unpriced order in that it contains quantity and trade side terms, but is distinguished in that two sides
20 (both buy and sell) of a transaction are submitted to the system as a unit to be crossed at the discovered price. Such an order type is essentially a tool to allow large blocks of shares of a particular stock to be traded quickly between two accounts at a market
25 determined price (the discovered price). The opposing sides of a cross order cannot be broken up. If no price is discovered by the execution of priced orders within that particular auction cycle, cross orders will have the option of being returned unexecuted, being
30 held over for the next auction cycle, or being crossed at a reference price that will be computed as part of the auction process.

Every order request containing one or more order types received from qualified participants during the

order acceptance period is entered into an order book. In preferred embodiments of the invention wherein computerized systems are employed, the order requests may be received via phone, fax, or electronically via computer network connections. Preferably, the order book is maintained electronically, such as in the form of a computer database.

During the entire order entry period, the orders contained within the order book are kept confidential. This feature therefore allows participants to submit new order requests, or requests seeking to cancel or modify existing orders throughout the entire order acceptance period without introducing the adverse effects caused by gaming.

At the beginning of the second period of the auction cycle, the price discovery period, no more new order requests are accepted, and the order book is examined to identify for each asset in the auction, the price at which the asset will trade. If after crossing the orders in the order book, there is identified either a single price at which a maximum number of shares of a given asset will be exchanged, then that price is considered optimal and is set as the discovered price for that asset. If a range of prices is identified which would cause a maximum number of shares of a given asset to be exchanged, then an optimal price that reflects supply and demand considerations is selected from the identified range of prices and is set as the discovered price. In the event that no share maximizing price or range of prices is identified (as is the case where priced orders do not intersect after crossing), a reference price is set as the discovered price. A suitable algorithm for

determining both a discovered price and a reference price is described in detail below.

In accordance with a preferred embodiment of the present invention, at the beginning of the price
5 discovery period as depicted in figure 1, a determination 100 is made as to whether an optimal price ("P₀") can be discovered which will maximize the share transaction quantity 101, or whether there are no intersecting priced orders such that a reference price
10 must be used 102. Where there are intersecting priced orders, the invention proceeds to discover an optimal price using a price discovery algorithm 103.

The price discovery algorithm 103 employed during the price discovery period of auction cycles in
15 embodiments of the present invention uses the information contained in priced orders in the limit order book for each auction cycle to calculate, based upon relative supply and demand, a discovered price. This is the price at which all trades of a given
20 security will occur for that particular auction cycle. Preferably, the operation of the price discovery algorithm is automated, such as by software running on a computerized network.

Figure 2 depicts in detail the operation of a
25 preferred price discovery algorithm 103 according to the present invention. To begin the price discovery algorithm, the order book ("O.B.") is examined 200 to identify a price 201 for a given security at which the volume of shares traded will be maximized. In the
30 event that a single security price 202, a "discrete" price, is identified which will cause a maximum amount of shares (from priced orders) to be executed, that discrete price is identified as the discovered price 203.

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The volume of unpriced orders will be included in the cumulative supply and demand of volume. For example, if there are 50,000 units of unpriced buy orders and 25,000 units of unpriced sell orders, these shares will be added to volume of priced buy and sell orders, respectively, at each price. If unpriced orders meet priced orders that do not intersect, these unpriced orders will cross at the volume-maximizing price with the corresponding priced orders. In the event that there are only unpriced buy and sell orders, the unpriced orders will trade at the reference price.

30

Buyer A enters a priced order offering to buy 10,000 shares at a price of 50.00, and an unpriced order offering to buy 50,000 shares at the determined price.

Buyer B enters a priced order offering to buy 5,000 shares at a price of 50.10.

5 Seller X enters a priced order offering to sell 20,000 shares at a price of 50.30, and an unpriced order offering to sell 25,000 shares.

Seller Y enters a priced order offering to sell 15,000 shares at a price of 50.20.

10 Between A, B, X, and Y there are unpriced and non-intersecting priced buy and sell orders on for the particular auction cycle. At a price of 50.00, buyer A would be willing to buy a total of 60,000 shares and buyer B would be willing to buy a total of 5,000 shares. Thus, aggregate demand at a price of 50.00 is 65,000 shares. At this price, neither of seller X's or seller Y's priced orders would be executed. Thus, aggregate supply would equal the total number of unpriced order shares, 25,000.

20 At a price 50.10, buyer B is willing to buy a total of 5,000 shares, buyer A is willing to buy a total of 50,000 shares (this number being the number of unpriced shares ordered by buyer A). For this price, again neither seller X nor seller Y are willing to buy any priced shares.

25 Therefore, aggregate supply is 25,000 shares.

At a price of 50.20, aggregate demand equals 50,000 shares (this being the number of shares represented by unpriced buys), and aggregate supply is 40,000 shares (this being the number of shares available for sale at a price of 50.20 plus the number of unpriced shares offered).

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At the price of 50.30, aggregate demand equals 50,000 and aggregate supply equals 60,000.

Taking the smaller of aggregate demand and aggregate supply at each of the above prices, we will find the total number of shares which will transact at that particular price. Thus, at a price of 50.00, 25,000 shares would be transacted, at 50.10, 25,000 shares would be transacted, at 50.20, 40,000 shares, and at 50.30, 50,000 shares. Therefore, the maximum amount of shares will transact at a share maximizing price of 50.30 wherein 50,000 shares will be executed.

Often, a discrete price cannot be identified. In these circumstances, the price discovery algorithm used in embodiments of the present invention will identify a range of prices 204 that will cause a maximum amount of shares to be executed. Along this range of prices, the amount of shares traded would be constant. In instances where a discrete price cannot be identified, the price discovery algorithm uses the relative amounts of bids (offers to buy) and offers (offers to sell) to determine which price along the range of volume maximizing prices will be discovered.

The price discovery algorithm according to embodiments of the present invention in circumstances where no discrete price is identified first makes a determination 205 as to whether the bid shares are substantially equal to the offered shares. This can be done, for example, by mathematically computing an imbalance ratio ("R") defined as

$$R = \frac{|B - O|}{L} \quad \text{Equation 1}$$

wherein "B" is defined as the number of shares bid to buy at the highest price within the volume maximizing

range, "O" is the number of shares offered to sell at the lowest price within the volume maximizing range, and L equals the lesser of O or B. This imbalance ratio is then compared to a predefined standard ("S") for the given security.

Next, in preferred embodiments of the invention the price discovery algorithm compares the imbalance ratio R to the standard S at 206. If the imbalance ratio is less than the appropriate standard 207, the discovered price is identified as the mid-point price within the share volume maximizing range of prices 208. This represents a determination that the net order imbalance is not large enough to significantly impact price.

Example 3

Same facts as example 1, except that X and Y only wish to sell 5,000 shares apiece for $3/8$.

The standard "S" for the particular stock in question is 0.25 (representing a belief that a 25% excess of supply over demand, or vice versa, would constitute a large enough net order imbalance to significantly impact price).

Using equation 1, B is 10,000, O is 10,000, and L is 10,000, thus R is calculated to equal 0.00 (i.e., no net order imbalance). Since R is less than S, the net order imbalance is deemed to not significantly impact price.

Given that X and Y will sell 5,000 shares apiece (10,000 total) whether the price is $1/2$ or $3/8$ (there is no single volume maximizing price) and that R is less than S, the discovered price will be the mid-point of the volume maximizing range ($3/8$ to $1/2$). Thus, the price is $7/16$.

If the imbalance ratio is greater than the appropriate standard 209, the imbalance of supply and demand of the particular stock within the volume maximizing range is considered to have become large enough to impact price. Where the number of shares bid for is found to significantly outnumber the number of shares offered 210 ($B > O$), the market price is considered demand driven 211 and results in a discovered price equal to the highest price within the share maximizing range. Conversely, where offers significantly outweigh the number of bids ($O > B$), the market price is supply driven 213 and results in a discovered price equal to the lowest price within the share maximizing range 214.

Example 4

The same facts as in example 3, except that a third buyer, Buyer C, submits a priced order to buy 10,000 shares at $1/2$.

Using equation 1, B is 20,000, O is 10,000, and L is 10,000, thus R is calculated to equal 0.50. Since R is greater than or equal to S (in this instance $S = 0.25$), the net order imbalance is deemed to significantly impact price.

This net order imbalance creates a demand driven price, thus the discovered price is set to the highest price within the volume maximizing range, namely $1/2$.

In alternative embodiments of the present invention, more than one standard may be used. In addition to the standard S which, if exceeded, denotes order imbalances which are large enough to warrant completely tipping the price to either the highest or lowest price within a range, a lower preliminary

standard S' can be used to measure when a predetermined partial tipping of price should be employed. Thus, if $B > 0$, and $S > R > S'$, the price would not be demand driven, but only demand pressured. In situations where
 5 price is demand or supply pressured, the discovered price would be offset somewhere between the midpoint and the appropriate endpoint of the price maximizing range.

Example 5

10 Buyer D enters a priced order offering to buy 75,000 shares of stock IOU for 50.35.

Seller Z enters a priced order offering to sell 50,000 shares of stock IOU for 49.95.

15 Stock IOU has a standard, S , set within the auction system equal to 0.60, and a preliminary standard, S' , set within the auction system equal to 0.40.

For this example, at any price within the range of 49.95 through 50.35, 50,000 shares of IOU
 20 will be exchanged. Using equation 1, the imbalance ratio, R , is calculated to be 0.50, which is less than S , but larger than S' . Thus the price is considered to be demand pressured, but not demand driven. Therefore, the determined
 25 price will be selected from a price somewhere between the demand driven price, 50.35, and the mid-point of the bid-offer spread, 50.15. A suitable price, for example, could be 50.25, the mid-point of the range of demand pressured prices.

30 As will be readily apparent to those of ordinary skill in the art, the standard(s) with which to compare the imbalance ratio to can vary from security to security and based upon prevailing market conditions.

When embodiments of the present invention are performed electronically, the standard can be linked to market indicators (security Beta and volatility, for example) preferably provided continuously by an independent electronic wire service. Further, the value of the standard for a single security can be dependent upon whether there is a demand driven ($B > O$) or supply driven ($O > B$) imbalance.

Referring again to figure 1, at the end of the price discovery algorithm 103, the price at which the security will trade for that particular auction cycle is set equal to the discovered price 105.

For those auctions where no share maximizing price or range of share maximizing prices is discovered 102, such as in the case where there are no buy and sell priced orders which intersect so as to define a share maximizing price, a default price, termed the reference price (" P_R "), that is derived from a combination of the orders currently in the order book and continuous market quotes, will be computed according to a reference price algorithm 104. This reference price in turn, as described above, will be used to execute cross orders and unpriced orders 106. Details of the reference price calculation will depend on the specific implementation of the system.

In preferred embodiments of the invention, the reference price calculation algorithm will be performed by software running on one or more computers. Referring to figure 3, the manner in which the reference price is set depends upon whether the underlying primary market for asset is open 300. For an auction cycle occurring while the underlying market is open 301, the price of the asset on the underlying market can serve as a suitable estimate of the optimal

price. Thus, when no volume maximizing price can be identified by the price discovery algorithm due to lack of crossed orders, the mid-point of the of the most recently published unqualified complete quotation (quotation having a valid bid, bid size, valid offer, and offer size; hereinafter, "MRPUCQ") reported by the underlying continuous market prior to the beginning of the price discovery period is set as the reference price 302 for that auction cycle.

For a batch auction cycle occurring while the underlying continuous trading market is closed 303, quotes from trading in the continuous market cannot be used to set the reference price. When the underlying security market is closed 303 and there are no priced buy or sell orders within the system, the reference price can optionally be defined as either the most recently published unqualified trade price ("MRPUTP") 306, which can be obtained from a consolidated tape system or other real time quote service as is known in the art. Alternatively, at step 306, the reference price in such a situation can be set as the mid-point of the closing quote for the asset.

In closed market situations where the order book has priced orders 307 (which are all either on one side or are non-intersecting such that no price can be identified by the price discovery algorithm), the reference price in preferred embodiments of the invention can be set equal to one of three values depending in part on whether there are solely offers solely bids, or both 308. Where there are only priced bids 310 and no priced offers, and the highest bid 314 is higher than the MRPUTP 316, the reference price is set equal to the highest bid price 319. Where there are only priced offers 309, and the lowest offer 311 is

lower than the MRPUTP 312, the reference price is set equal to the lowest offer price 317. In all other cases, where there are non-intersecting bids and offers 319, only offers and the lowest offer is greater than
5 the MRPUTP 313, or only bids and the highest bid is less than the MRPUTP 315, the reference price is set equal to the MRPUTP.

As will be appreciated by one skilled in the art, various modifications may be made to the above
10 reference price and price discovery algorithms without departing from the scope and spirit of the invention. For example, both the price discovery and reference price algorithms may be constrained to produce results within a certain range, such as within the bid-offer
15 spread of the underlying primary market. Additionally, constraints may be imposed which require the determined price obtained from either price discovery algorithm or the reference price algorithm to move in discrete steps according to a minimum price variation (or "minimum
20 tick") as defined by the system or by exchange rules. Thus, the price could vary, for example, according to 1/16, 1/32, or 1/64 of a dollar, or \$0.01 increments.

After a discovered price is identified by the price discovery algorithm or alternatively a reference
25 price is identified by the reference price algorithm, the price discovery period ends and the final part of the auction cycle, the order execution period, begins. During this final period, the volume maximizing amount of shares which are executed at the discovered price
30 are fairly allocated among "qualifying" orders. Qualifying orders include all unpriced orders as well as priced orders that are at least as aggressive (bid orders having a price greater than or equal to the discovered price, and offer orders having a price less

than or equal to the discovered price) as the discovered or reference price. During the order execution period, each qualifying order will receive a pro-rata allocation of the available liquidity, i.e., the shares of the given security which will be traded during that particular auction cycle.

Example 6

Given the facts according to example 3, the full 10,000 shares sold by X and Y at 7/16 is allocated to A because the discovered price is higher than the price entered by B. Thus, A is the only buyer willing to pay the discovered price.

Example 7

Given the facts according to example 4, the 10,000 shares sold by X and Y at $\frac{1}{2}$ is allocated pro-rata to each buyer willing to meet that discovered price. Buyers A and C are both willing to buy up to 10,000 shares apiece at a price of $\frac{1}{2}$, thus the shares are allocated equally between them. Thus, A and C are each allocated 5,000 shares at $\frac{1}{2}$.

After the trades are allocated among qualifying orders, each trader is preferably notified of the results of their order, including whether a trade did or did not occur, whether their order was a qualifying order, the price at which trades occurred (if applicable), and the quantity traded shares allocated to him (if applicable). Optionally, in embodiments of the present invention, other information can be provided to the trader post auction including the net order imbalance and total number of shares executed. When qualifying orders are electronically submitted,

trader notification of auction results can be performed electronically as well.

5 A batch auction system in preferred embodiments of the present invention is connected to one or more ECNs such that non-executed shares can be sent automatically to outside sources for execution. Thus, participants who had submitted priced orders having less aggressive prices than the discovered price, or having a net order imbalance, could opt to have their desired trades
10 completed outside the batch auction.

As will be apparent to one of ordinary skill in the art, the present system can be modified in a variety of manners to provide additional functional features. By way of example, the permissible order
15 types may be modified, or new order types introduced in alternative embodiments of the present invention. Such a new order type could be in the form of a "contingent order" which represents a desire by the trader to "only buy security A if I can sell security B and the price
20 ratio of A:B is less than X." Also by way of example, order types may be modified to allow the specification of portfolio dollar constraints. Such constraints would permit a series of orders for different securities to be linked as a portfolio, and only permit
25 orders in that portfolio to be executed to the extent that maximum levels (in value terms) of net buying and selling are not exceeded.

The invention being thus described, it will be apparent to those skilled in the art that the same may
30 be varied in many ways without departing from the spirit and scope of the invention. Any and all such modifications are intended to be included within the scope of the following claims.

What is claimed is:

1 1. A method for identifying a price at which to
2 conduct a batch auction of a financial asset,
3 comprising the steps of:

4 accepting a plurality of order requests from a
5 plurality of sources, said order requests containing
6 orders representing a desire to trade the financial
7 asset within certain order parameters, a portion of
8 said orders optionally containing a desired order
9 parameter;

10 selecting the price at which to trade the asset by
11 examining said priced portion of said orders, including

12 determining from said priced portion of said
13 orders whether there exists a single price at which a
14 maximum number of shares of said asset will be traded,
15 and, if so, selecting said single price as a selected
16 price,

17 if there does not exist such a single price,
18 calculating an imbalance ratio of purchase requests of
19 said asset to sale requests of said asset, and
20 determining the selected price based on the result of a
21 comparison of said imbalance ratio to a predetermined
22 reference value;

23 exchanging a number of shares of the asset at the
24 selected price; and

25 allocating said number of shares among said order
26 requests.

27
28 2. The method for identifying a price at which to
29 conduct a batch auction of a financial asset according
30 to claim 1, wherein said number of shares is a maximum
31 number of shares which can be exchanged based upon said
32 order requests.

1 3. The method for identifying a price at which to
2 conduct a batch auction of a financial asset according
3 to claim 2, wherein said maximum number of shares is a
4 factor for selecting the selected price.

5 4. The method for identifying a price at which to
6 conduct a batch auction of a financial asset according
7 to claim 1, wherein the selected price lies within a
8 range identified by a bid-offer spread of the asset on
9 a market for the asset.

10 5. The method for identifying a price at which to
11 conduct a batch auction of a financial asset according
12 to claim 1, wherein said order parameters include a
13 trade side, a security identifier, a price, and a
14 quantity of shares.

15 6. The method for identifying a price at which to
16 conduct a batch auction of a financial asset according
17 to claim 1, wherein said orders have order types
18 selected from the group consisting of unpriced orders,
19 cross orders, and priced orders.

20 7. The method for identifying a price at which to
21 conduct a batch auction of a financial asset according
22 to claim 6, wherein said cross orders comprise order
23 parameters including a security identifier, and a
24 quantity of shares, and wherein said cross order
25 represents a desire to directly exchange said quantity
26 of shares at the selected price.

27 8. The method for identifying a price at which to
28 conduct a batch auction of a financial asset according
29 to claim 1, wherein said exchanged shares are allocated

1 pro-rata among said orders whose parameters are met by
2 said selected price.

3 9. The method for identifying a price at which to
4 conduct a batch auction of a financial asset according
5 to claim 1, wherein said selecting step is performed
6 according to an algorithm selected from the group
7 consisting of a price discovery algorithm and a
8 reference price algorithm.

9 10. The method for identifying a price at which to
10 conduct a batch auction of a financial asset according
11 to claim 9, whereby said selected price is selected so
12 as to maximize an amount of exchanged shares.

13 11. A computerized system for identifying a price at
14 which to conduct a batch auction of an asset,
15 comprising:

16 a computerized network having one or more computers
17 in electronic communication with each other;

18 an order receiving program running on one or more of
19 said computers, wherein said receiving program is
20 designed to receive a plurality of messages containing
21 orders from one or more qualified participants;

22 an order book database located on one or more of
23 said computers, wherein said order book database
24 communicates with said order receiving program and
25 stores each of said orders received by said receiving
26 program;

27 a price selection program running on one or more of
28 said computers, wherein said price selection program
29 refers to said order book database and calculates a
30 selected price at which to transact a maximum number of
31 shares of the security during the batch auction;

1 17. The computerized system according to claim 11,
2 wherein said predetermined criterion comprises a pro-
3 rata distribution of said maximum number of said shares
4 among said orders having a price requirement at least
5 as aggressive as said single price.

1 18. The computerized system according to claim 11,
2 wherein said price selection program identifies said
3 single price according to a price discovery algorithm
4 and a reference price algorithm.

1 19. The computerized system according to claim 11,
2 wherein said single price is constrained to lie within
3 the bounds identified by a bid-offer spread of the
4 asset on a market for the asset.

1 20. The computerized system according to claim 11,
2 further comprising an electronic connection to an
3 external data source, said data source providing market
4 information regarding the asset.

1 21. A method for conducting a security batch auction
2 cycle for an asset at a single price, said auction
3 cycle having an order acceptance period, a price
4 discovery period, and an order execution period, said
5 method comprising the steps of:
6 during said order acceptance period, accepting
7 requests to enter auction orders into an order book;
8 during said price discovery period, determining
9 whether said orders will intersect,
10 if said orders intersect, identifying one or more
11 prices at which the batch auction cycle would produce a
12 maximum number of executed shares, selecting one of

1 said one or more prices as an optimal price, and
2 setting said optimal price as the single price; or
3 if said orders do not intersect, selecting a
4 reference price, and setting said reference price as
5 the single price; and
6 during said order execution period, executing a
7 trade of said maximum number of shares at said optimal
8 price, and allocating said executed maximum number of
9 shares among the orders according to a predetermined
10 criterion.

ABSTRACT OF THE DISCLOSURE

A method and system for determining an optimal price at which to perform a batch auction of financial assets. Orders, according to a variety of
5 predetermined order types, are received from qualified market participants and communicated to an auction system according to the invention. The auction system takes into account each order and its impact upon relative supply and demand to determine by a preset
10 algorithm an optimal price and share transaction quantity. The optimal price is selected by identifying a particular price at which trade volume would be maximized and which reflects the appropriate effect of supply and demand imbalances. Trades are executed at
15 the optimal price, and portions of the transaction quantity are allocated to each investor on a fair basis dependent upon their submitted orders. In another aspect, the auction system includes a computer system and network designed to automatically perform one or
20 more steps of the above method. Such a system is preferably connected to one or more ECNs such that non-executed shares can be automatically sent to outside sources for execution, and connected to real time quote services to obtain current market information.

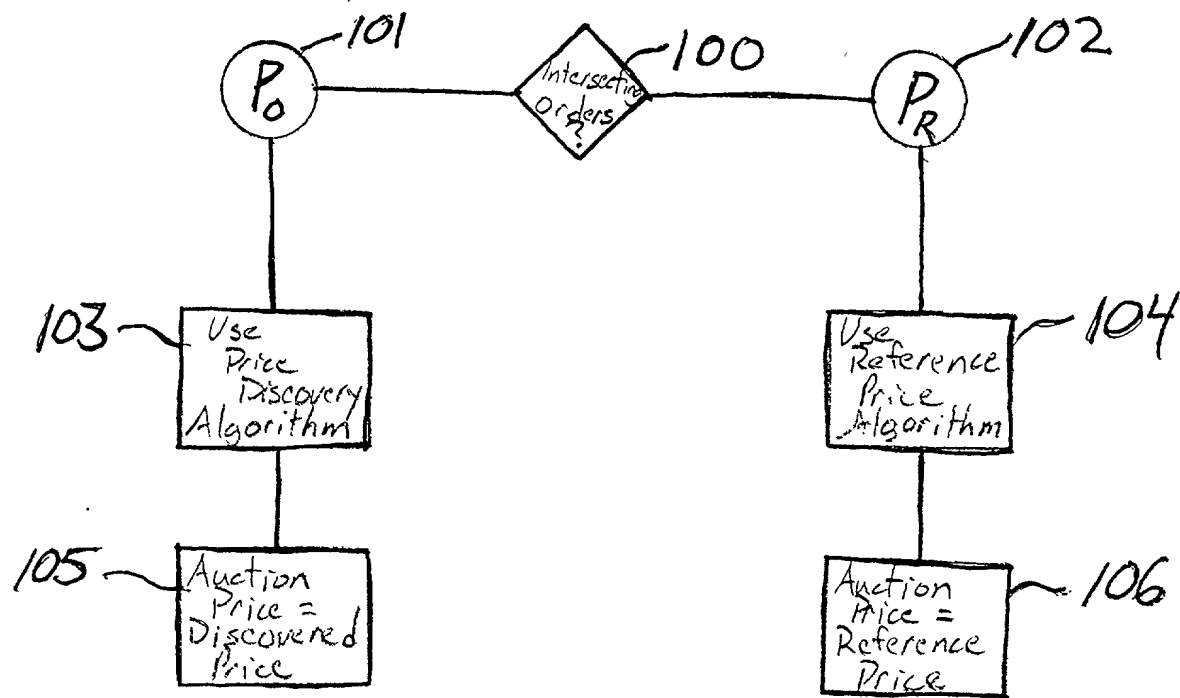


Figure 1

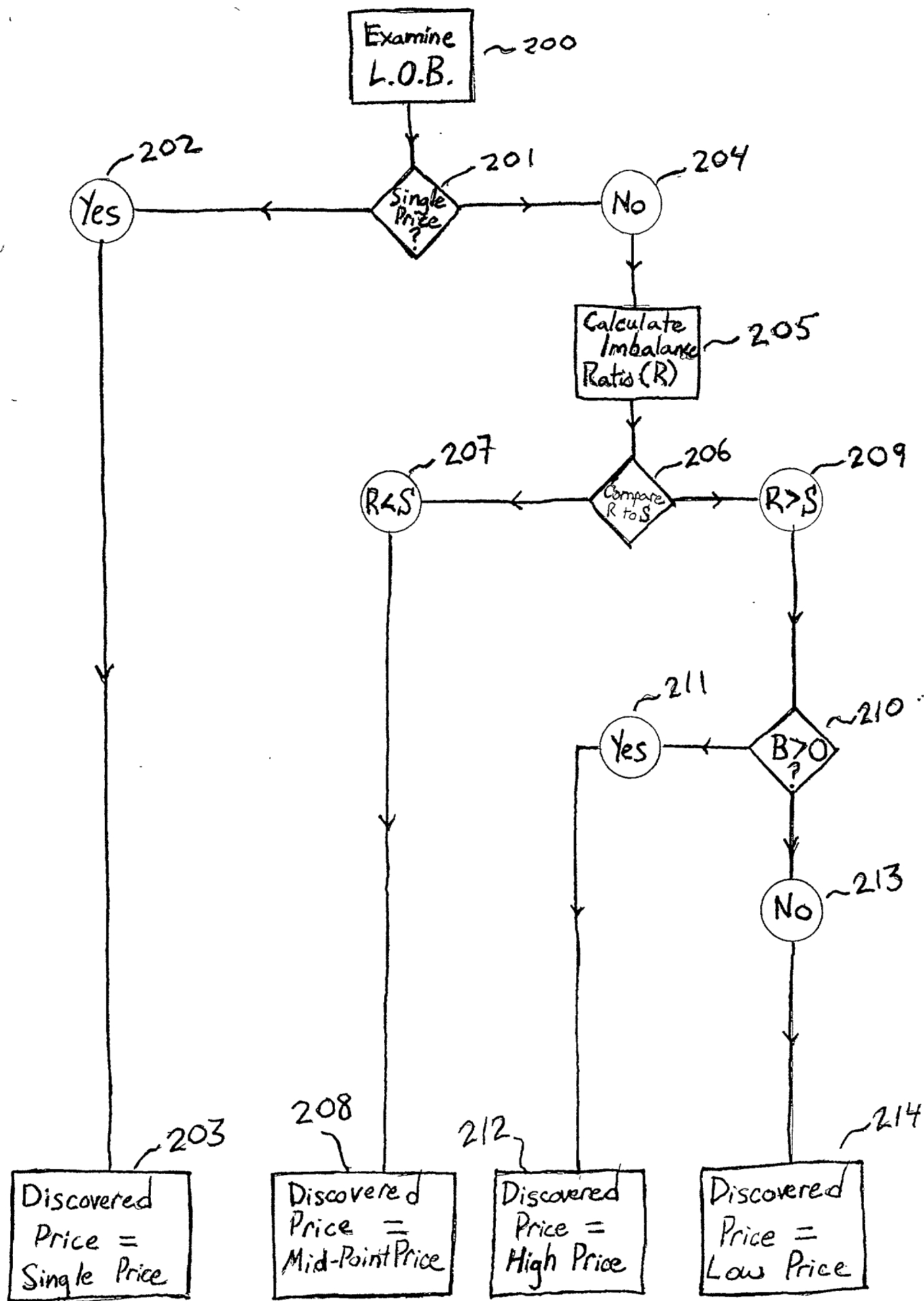


Figure 2

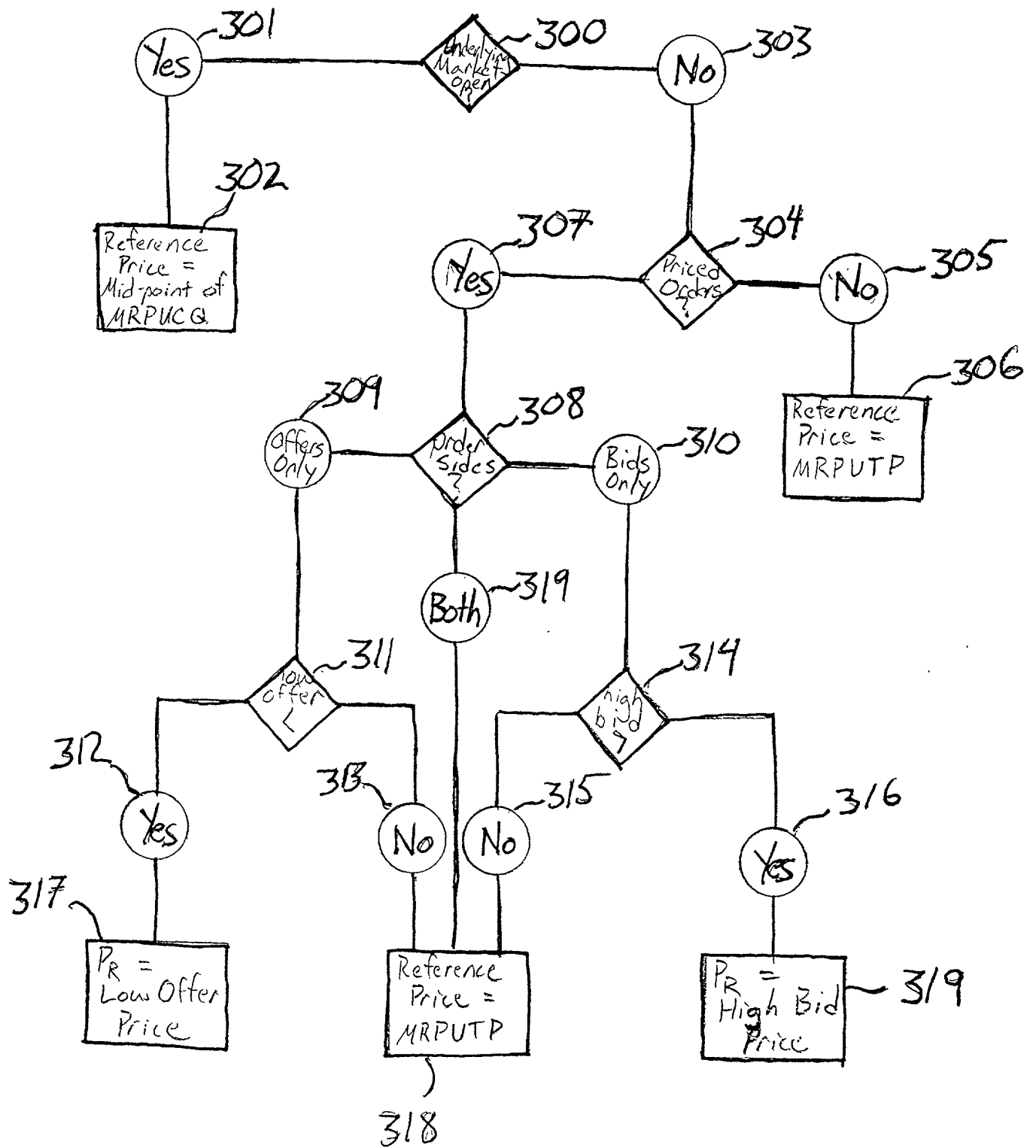


Figure 3

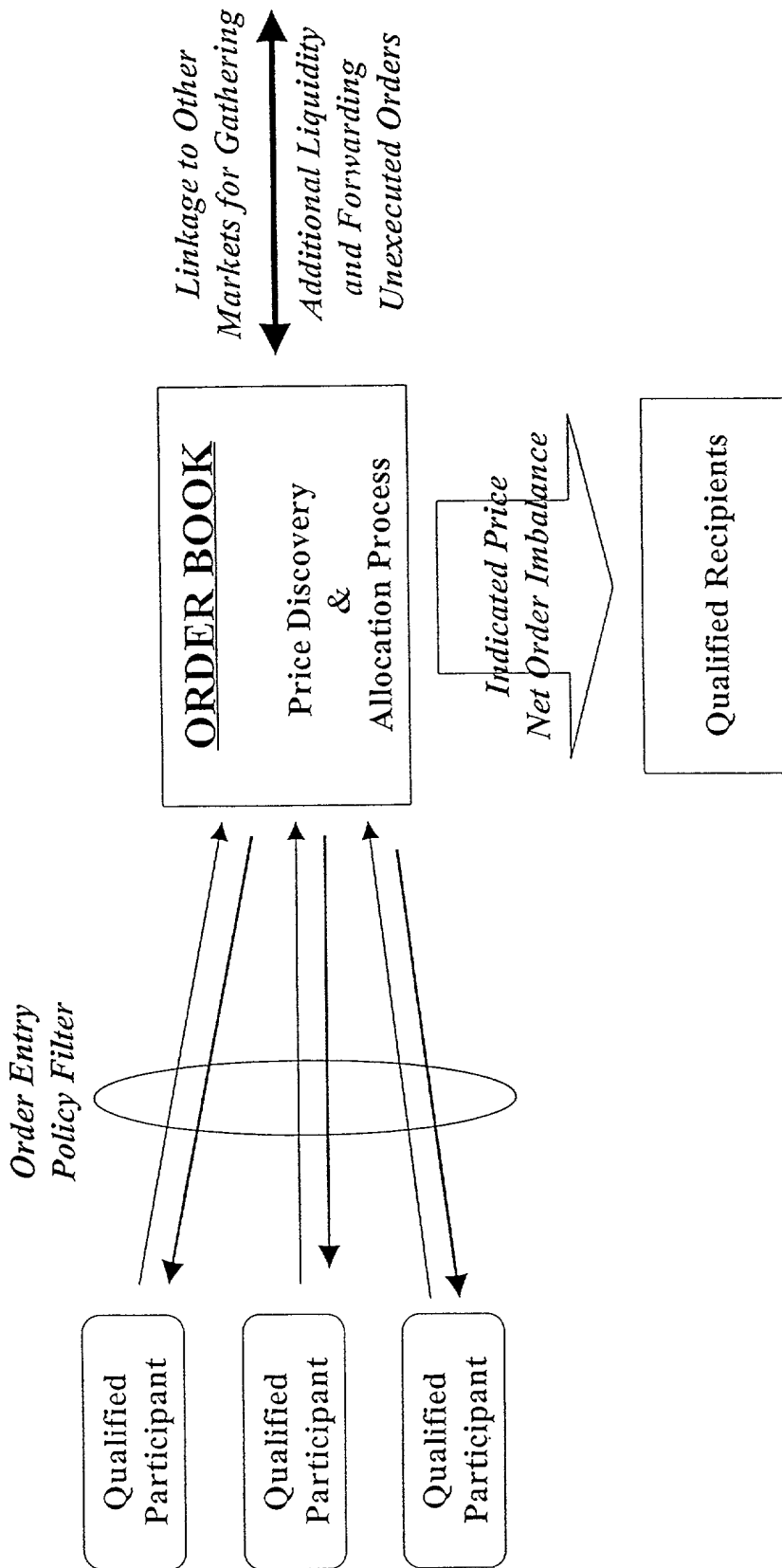


Figure 4

Declaration and Power of Attorney for Patent Application

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought, on the invention entitled METHOD AND SYSTEM FOR OBTAINING A DISCOVERED PRICE, the specification of which

☒ is attached hereto.

☐ was filed on _____
Application Serial No. _____
and was amended on _____

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

_____	_____	_____	Priority Claimed	
(Number)	(Country)	(Day/Month/Year)	<input type="checkbox"/>	<input type="checkbox"/>
			Yes	No

Prior Foreign Application(s)

_____	_____	_____	Priority Claimed	
(Number)	(Country)	(Day/Month/Year)	<input type="checkbox"/>	<input type="checkbox"/>
			Yes	No

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

(Application Serial No.)

(Filing Date)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)

(Filing Date)

(Status)

(Application Serial No.)

(Filing Date)

(Status)

I or we hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and request that all correspondence about the application be addressed to ROTHWELL, FIGG, ERNST & KURZ, p.c., Suite 701-E, 555 13th Street, N.W., Washington, D.C. 20004

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

DATE _____

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1/28/00

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THIRD NAMED INVENTOR

SIGNATURE

DATE _____

RESIDENCE

CITIZENSHIP

POST OFFICE ADDRESS

FOURTH NAMED INVENTOR

SIGNATURE

DATE _____

RESIDENCE

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